

not excessive for a summer thunderstorm, the temperature of 0°C . will be encountered at an altitude of not less than 3,000 meters and often more.

To return to the action of "niagaras" on hail; I will cite only three cases, taken from localities where the observations are unquestioned.

Since a "niagara" was installed on the Eiffel Tower, the falls of hail have not been less frequent than formerly in the quarter of the Champ-de-Mars and especially at the Bureau Central Météorologique [near the base of the Tower], where they have been observed and recorded with the greatest of care. The complete list of hail falls can be published, if necessary.

The lower station of the Observatoire de Puy-de-Dôme is situated in a freely exposed location on a plateau, in the suburbs of Clermont-Ferrand. A steel skeleton tower (pylône en fer) 31 meters high, has been constructed to carry the anemometers and is equipped with a "niagara." In the annual report of the director we read that hail fell twice on the "niagara" in 1912 and four times in 1913. Particularly on August 29, 1913, the hailstones averaged the size of a pigeon's egg and were sometimes the size of a hen's egg. Mr. Mathias concludes from his observations that "the hail-dispelling ability of the 'niagara,' theoretically improbable, has not been experimentally demonstrated."

Still more instructive observations are those of the Observatoire de Bordeaux, situated at Floirac, which was provided with a "niagara" September 22, 1912. The commune of Floirac was devastated by hail on August 15, 1887; but for the succeeding 25 years it had been immune. Again in 1912, two disastrous falls of hail occurred at Floirac, one on July 5, before the installation of the "niagara," the second on October 20, when a heavy shower of very large, hard hailstones fell upon the "niagara" itself during a period of two and a half minutes. Stones picked up 35 minutes after the fall were found to be spherical in form and opaque and on an average the size of a small pea. One of the observatory officials collected and sketched a number of very remarkable forms of hailstones that had fallen at the foot of or within less than 40 meters of the steel tower of the "niagara."

These observations show how necessary it is to be conservative in expressing appreciation of the efficiency of hail-fighting apparatus. Because there has been no hail in a place, one has no right to conclude that the processes employed, cannons, rockets, or "niagaras," have prevented the hail. A region devastated by hail may be spared for 25 years, although not supplied with any form of protection, and hail may visit it again twice in the same year a paragrêle is installed at that place.

Under these conditions, I should not recommend the extension of the system of electric "niagaras;" in my opinion there are already more than enough to continue observations which, it seems to me, must inevitably lead to negative conclusions.

On the contrary, it will be very important to have numerous exact observations on the falls of hail in France. At the present time the available stations do not enable us to draw charts showing the distribution of hail, that are sufficiently detailed to be valuable. I pointed out this insufficiency more than 10 years ago in studying the storms of 1903, and I have shown that in order to make a complete study of the distribution of hail over a small Department like the Rhône, it would be necessary to have from 280 to 300 stations uniformly distributed. A large Department like the Gironde or the Dordogne would need about 1,000 stations. These numbers suffice to show the difficulties of the problem.

A NEW TURBIDIMETER.

By P. V. WELLS.

[Dated U. S. Bureau of Standards, Apr. 29, 1914.]

[Author's abstract.]

A systematic study of turbidity for the purpose of defining a proper standard is much needed. The paper describes an instrument in which the turbidity is measured by the light diffracted from the particles. A collimated beam from an intense source such as a Nernst or tungsten filament passes through a variable thickness of the turbid medium, and is totally reflected by a prism, thence forming a uniform beam in one field of a photometer. The diffracted light is not totally reflected, but is refracted by the prism into the other aperture of the photometer. Thus the reading is a function of the ratio of the intensities of the light scattered and transmitted, which, in turn, varies with the turbidity.

The instrument is adapted to liquids, gases, and solid plates. Minute traces are measurable with photometric precision, while the range is widened by varying the thickness of the medium. The characteristics of a preliminary instrument constructed at the Bureau of Standards are discussed.

In connection with the above, Dr. S. W. Stratton, Director, United States Bureau of Standards, writes: "It may be of interest to know that the bureau is planning to use a form of the instrument in the study of fogs as a part of the work of the [International] Ice Patrol."

THE LOWEST TEMPERATURE OBTAINABLE WITH SALT AND ICE.¹

By ROSS AIKEN GORTNER, Physiological Chemist.

[Dated, Carnegie Instit. of Washington, Dept. Exper. Evolution.]

* * * While discussing freezing mixtures with a friend recently I stated that a temperature of -19°C . could be easily obtained and maintained for some hours with an ice and salt mixture. My friend questioned the accuracy of the thermometer, inasmuch as -19°C . is below 0°F . (-17.78°C). I have, therefore, made a careful test to ascertain whether an ice and salt mixture may not show a lower temperature than 0°F .

About a gallon of finely chopped, hard ice was mixed with a quart or more of coarse salt in a water-tight wooden box, the wooden box being used because of the insulation which it afforded. The temperature was then observed with five thermometers. * * *

Thermometers 1, 2, and 3 ["Anchutz normal"] gave the same temperature for the ice and salt mixture, i. e., -21°C ., which is the equivalent of 5.8° below zero Fahrenheit. Thermometer 4 was graduated only to -19°C ., and the mercury was some distance below the bottom of the scale. A reading of -20° to -21°C . was made [by extrapolation]. Thermometer 5 gave a minimum of -4°F ., while the Weather Bureau [minimum] thermometer (No. 6) gave a reading of -5°F . [-20.56°C].

Previous to this experiment I had filled a wooden box holding perhaps 30 pounds of ice with a freezing mixture in the evening and placed it in an empty ice box to

¹ Extract from an article in Science, New York, Apr. 17, 1914, (N. S.), 38, p. 584-585.